Fuzzy Multivariate Approach to Corporate Brand Evaluation

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Fuzzy Multivariate Approach to Corporate Brand Evaluation

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Abstract

In the IT industry, intense competition has been carried out among corporations all over the world. In Japan, some corporations have been able to increase sales and production, but unfortunately many others have lost their power to push themselves forward. There are several reasons for this failure. First, we can pinpoint the recession in Japan as well as in the world economy. However, we need to understand the reasons why some corporations were successful in increasing production, even in the midst of recession. In this paper, we analyze detailed data on many representative Japanese corporations in the IT Industry. Today, balance sheets cannot be taken as indicators of corporate performance without taking into account brand value, customers, employees, patents and so on. We analyze Japanese IT corporations with a method that measures intangible assets. In particular, we put stress on the MOT and Brand Image in corporate value. The result of our analysis can explain why some corporations were successful.

1. Introduction

The United States leads the world economy. Since the 1990s, the U.S. alone has attained high economical growth in the midst of economic recession in the developed countries such as in Europe. To explain this, one can point to the Pro-patent Policy1, which started during the Reagan Administration, and in Science and Industrial Policy in the Clinton-Gore Administration, which drove the U.S. economy and strengthened the competitive power of American industries.

Nevertheless, the information and communications industry, which was a locomotive of the economy in Japan, Europe and the United States after the 1990s, lost its vigor after 2000 due to the bursting of the economic bubbles. This slowdown in the bubble economies led to the collapse and bankruptcy of major IT enterprises and the delay of 3rd Generation (3G) cellular phone services. Since 2002, the demand for new information communication devices and other related services has slowly gained strength, and the world economy has recovered little by little due to the restructuring of corporate operations.

1.1 Information industry corporations and economic growth

In the U.S. economy, productivity rose suddenly in the late 1990s, but then slowed from the middle of 2000. Although actual GDP recorded minus growth from January to

March 2001, personal consumption and facility investment recovered quietly after the period of October to December 2001.

In Europe, although the change in real GDP was small, the recession continued and the employment rate increased from July 2001 in Germany, France and the United Kingdom. On the other hand, real GDP recorded minus growth in three consecutive quarters between April-June and October-December, 2001, and facility asset investment by corporations has fallen. Therefore, GDP appears to have been rising from 2002.

1.2 Information Technology Industry in Japan

The market for information technology in Japan expanded from 79 trillion yen in 1995 to 123 trillion yen in 2001. It has become the locomotive of the Japanese economy since the collapse of the bubble economy.

However, just as in Europe, the information communications industry in Japan has suffered from stagnation in the personal computer business, cellular phone market and related services, leading to a worsening of the financial status of information communications firms beginning in 2000 and 2001. In particular, vendors depending on the U.S. suffered from the sluggishness in that market.

As a result of the collapse of the IT bubbles, the information technology economy has pulled the worldwide economy into stagnation. However, corporations in Japan retain a strong belief that the implementation of IT should be improving productivity and competitiveness. Also, great potential is said to lie in the expansion of e-commerce businesses.

2. Focusing on Intangible Assets

2.1 Observing intangibles

At the beginning of the 21st century, intangible assets are taking on an enormous role in the successful creation of wealth. Today, the forces with the greatest influence on economy are intangible factors, such as innovative ideas, new technologies and services. These intangible elements in fact can have a great influence on tangible assets. They also influence the potential of a company and its products, as well as the corporate brand image, and thus can have a great influence on profits. However, it is difficult to numerically measure their influences based on the present accounting system. We propose a method for assigning a highly credible numerical value to the invisible assets, though an understanding of its rules. The definition of "intangibles" in the accounting system is not clearly defined, and their monetary value cannot be evaluated.

In many companies, intangibles have greater value and make more contribution to growth than tangibles. Though financial reports provide an evaluation of intangibles, it is rare to find any explanation of the intangibles on the balance sheets. The corporation balance sheet shows the relationship among capital, assets, liability, stock aggregate market value and intangible management resources.

For entrepreneurs and managers, it is crucial to take care of intangible management resources that do not appear in tables. Intangible properties are important signs which can predict the future state of a company and have the potential to influence its future.

There are three important, and related, intangible properties. They are research fruits, the capital of the organization, and human resources. These intangible assets do not necessarily have a high return, although they do entail high risks, and it is difficult to convert them

into future profits. They can be created through advanced technical innovation and products, such as electric products, medical supplies, etc. The results of innovation and invention are protected by intellectual property legislation, such as patents, and these patents produce capital and funds. Such results raise the research level and market value of the company; leading in turn to growth of the intangible assets of the company.

Fundamentally, the intangible as well as tangible and financial assets are evaluated based on the balance of prospective profits to expenditures. It is difficult to secure profits against investment on intangibles, although it is easy for an investor to obtain some return from investment on tangibles.

Therefore, large sums of money are required in order to fully protect patent rights, trademarks, logos, etc. Furthermore, information on intangibles is not publicly released, so it is difficult to evaluate some assets because of the lack of data in general.

Figure 2 shows changes of sales, intangibles management resources and capital of

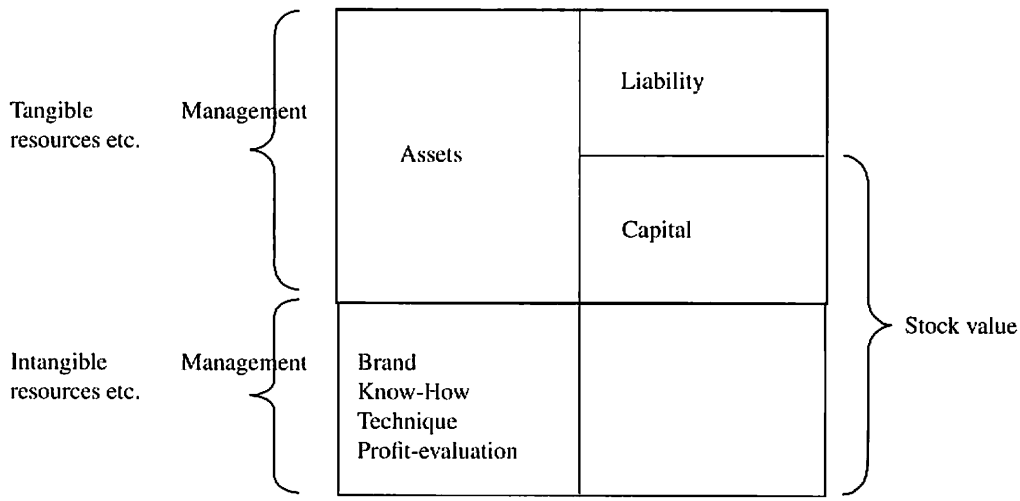


Figure 1. Balance Sheet by Ministry of Economy, Trade and Industry in Japan

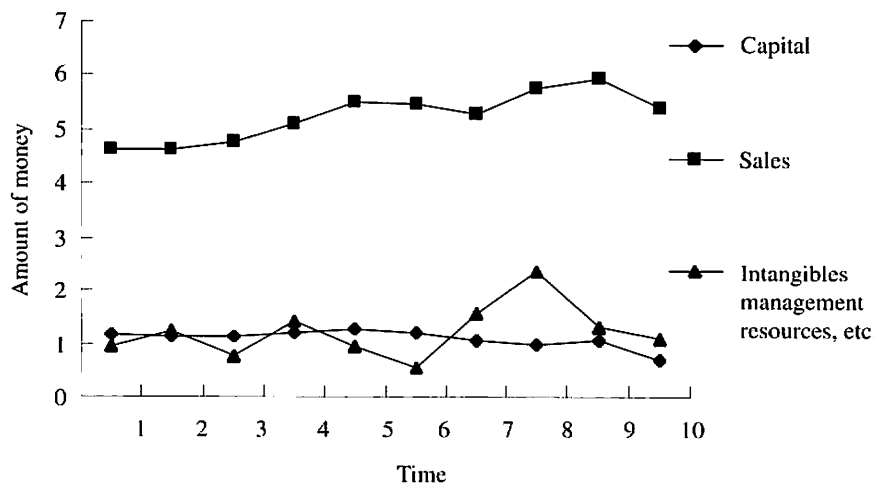


Figure 2. Changes over Ten Years for Toshiba

Toshiba over ten years. The final results of R&D (research & development) are calculated using the amount of sales volume. From the figure, it is clear that changes in the intangible management resources and other factors had a direct influence on the sales volume. Intellectual property includes brands, patents, sellable know-how, technologies, appraisal profits, etc. As these factors are related to one another, it is difficult to clarify the source of their influence. There are many uncertain factors, and it is difficult to measure and predict which will be most influential. We project the direction in which a company should move on the basis of our examination, measurement and analysis of these intangible management resources from various angles. Conventionally, information on intangible management resources such as research results is not disclosed explicitly, because the information is considered confidential. The intangibles helped companies with Japanese style management to achieve rapid growth. After the second half of the 1990s, however, some companies began to absorb large amounts of foreign investment. While the Japanese economy is at a turning point, from developing phase to maturity, it has become impossible for all companies to secure a stable source of funds. Therefore, stockholders have made selections and invested their funds into a limited number of companies in recent years. As a result, entrepreneurs have to take such factor into consideration as investment efficiency from the investors' point of views.

Before moving to the following section, we will emphasize that ROA is a measure of growth, and ROE of stability. From the perspective of emphasizing the profits of stockholders, it is expected that companies will try to raise the stock price while securing financial stability. They should adopt strategies that give consideration to these factors so that profitability and efficiency can be secured while maintaining stability. Based on this understanding, we will now give more concrete details about individual companies.

2.2 Intangible assets and patents

From the 1970s to the 1980s in the U.S., the productivity of a company was used to estimate the return on investment. A long period is required to harvest profits from investments into R&D. Estimates of R&D are made even more difficult by legal moves and the lawful concealment of company information. Therefore, highly reliable substitute indices are required. We propose two indices: the total capital and number of patents owned by a company. The relation between R&D and growth of the market value of a company is significant according to econometrics studies comparing R&D concentration and market value (price book-value ratio) of companies.

Figure 3 shows the total number of patents obtained by selected companies for the 11 years from 1993 to 2003, according to the Patent Office. It is difficult to evaluate individual companies using the data, because even if we limited our discussion to companies in the information technology industry, the companies have different scales of capital and emphasize various products including liquid crystal displays, digital audio, etc. For example, Sharp achieved excellent results among companies manufacturing electrical equipment. The consolidated sales volume in FY2002* was 99,400 million yen, an increase of 35.2% from the previous year, and the net interest was 32,500 million yen, an increase of 188.2% compared with the previous year. Sharp did very well, while other electronics companies in Japan faced troubles and spent greater efforts restructuring their company to overcome stagnation. Sharp achieved excellent results for liquid crystal devices and related products,

*) FY 2002; Fiscal year 2002 / from April 1, 2002 to March 31, 2003

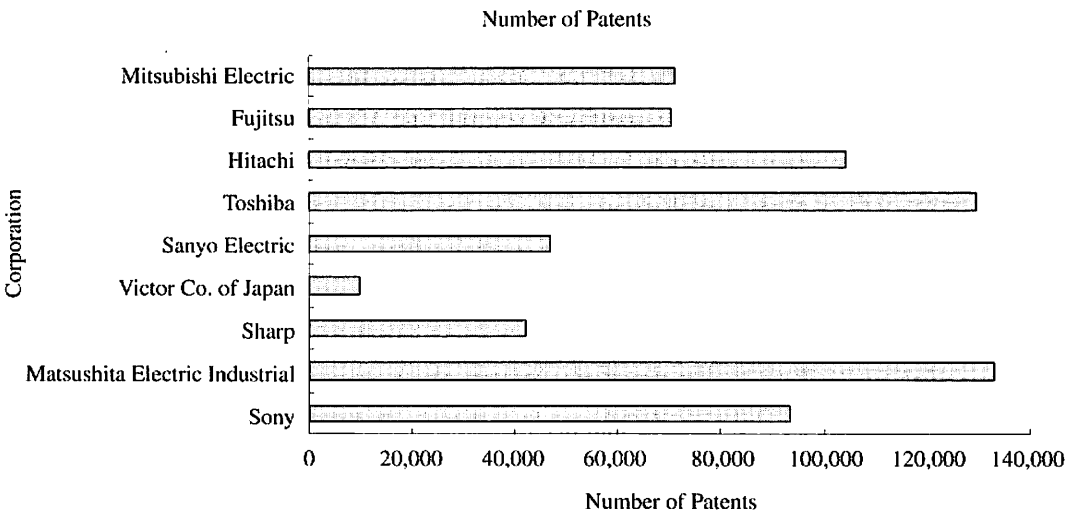


Figure 3. Comparison of Number of Patents Held by Selected Corporations

and succeeded in commercializing a cellular phone equipped with a camera in FY2002, before other companies. Thanks to this, there was a fashion boom in Japan of cellular phones with clear liquid crystal displays and beautiful digital cameras. This success derived from the development of CG-silicon as well as the use of thin type of CMOS[2] camera modules, signal processing LSI[3], etc. in the cellular phones equipped with a camera.

Sharp has created new trends in the electronics industry, such as liquid crystal television sets. In the Japanese domestic television set market, flat panel TVs expanded their market share to about 50 percent in monetary terms in the first half of FY2003. Although conventional cathode-ray tube TVs were the de facto standard up until that time, liquid crystal panel TVs are now taking their place. Looking at the market share by units sold in July 2003, Sony's share was 15.9% Matsushita Electric Industrial's 12.7%, and Sharp, with its "AQUOS" brand of liquid crystal television, had 61.8%.

Although Sony has now moved into other fields such as music, movies and insurance, in FY1995 its main profits came from electronics. Mr. Nobuyuki Idei, after assuming the presidency in 1995, began to build a structure to raise profits in each business, through for example the release of hot-selling product in the electronics (Vaio) enterprise of performance recovery (WEGA) of a movie enterprise and a music enterprise etc., the big hit "Playstation," and the hit robot "Aibo." It succeeded in creating the new products (WEGA-Vaio and PlayStation mobile terminal + contents service) in support of the strategy towards the realization of "Sony Dream World." Sony Dream World is intended to be the common future vision for Sony. A network strategy was adopted as the business model of the whole group, and the complete subsidiarization of Sony Chemical, Sony Music Entertainment Japan, and Sony Precision Technology was announced in accordance with the introduction of the company system in FY1996. The company also adopted a corporate officer system in June 1997. Organization reform started in April 2000, including the establishment of global, hub and electronics headquarters. The company has competitive power with many strategic products not only as part of its network strategy, but also as an electronics enterprise, which can also be called a basic enterprise, a game enterprise, an entertainment enterprise, an Internet communication service enterprise, and a financial enterprise. It is

easy for each stakeholder to understand the state of Sony through the motion of the whole group during the past six years.

For this study, we select nine companies from information technology industry whose patents have a significant influence on their development. We discuss these companies from various directions. In this research, we take FY1999 as the standard. And each figure was added the fuzzy figure.

3. Company Analysis

3.1 Sales ratio and number of patents

Figure 4 shows, for each of the companies, sales volume (%) in 2003 (normalized to 1999) and the number of published patents from 1993 to 2003. It shows that Sanyo and Sharp had figures of 1.20% and 1.14%, respectively rather high sales volumes considering the small number of patents they hold. A large number of patents does not always drive company achievement. Companies with relatively few patents that increase their sales volume are highly efficient in covering technology into sales.

On the other hand, the figure shows that Matsushita Electric with 132,906 patents, Toshiba with 1,296,178 patents and Hitachi, Ltd. with 104,099 patents were not able to transfer their patents into achievements. Considering its size, Sony showed solid performance, with a good balance between the number of patents (93,256) and sales percentage (1.09%).

3.2 ROE and a sales ratio

ROE can be understood from the viewpoint of stockholders as the ratio of profits to total equity. It shows how a company obtains profits by investing the accumulation of profits, in the form of internal reserves, into new business. Although it is rather easy to calculate ROE, and a larger value is better, it is not clear exactly what percentage will satisfy stockholders. The search for investment efficiency can result in a reduced balance.

It is difficult to make comparisons using the profit ratio and sales turnover for compa-

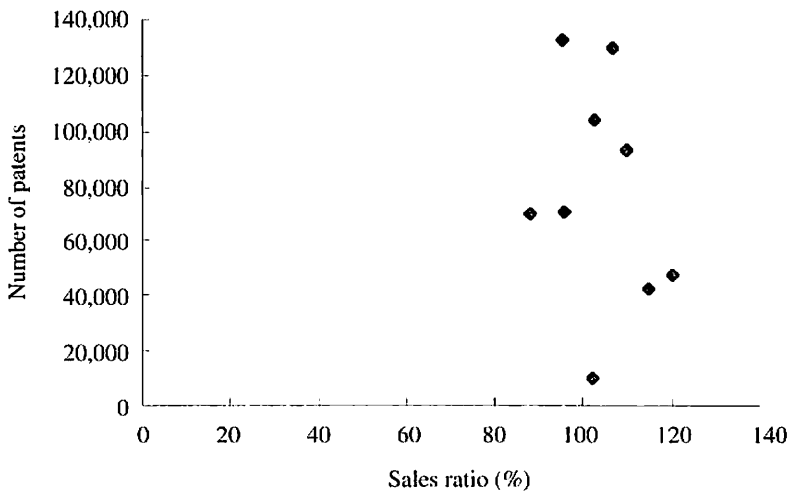


Figure 4. Analysis of Selected Corporations

nies in different industries, because of the acquisition-cost principle.

The calculation of ROE in Figure 5 is shown as follows:

$$ROE = \frac{income}{capital}$$

This formula shows that a falling stock equity leads to increased current term net profit.

The ROE value can be increased by making the net profit of the current term large and decreasing the stock equity. Among these, the net profit of the current term can be maximized through tax advance measures and by paying the corporate tax to the overall limitation.

On the other hand, to decrease the stock capital, it is possible to cut the total cost of capital requirements. This can be done by minimizing working capital, and selecting opportunities for business investment.

Additionally, when capital cost is decreasing, money lent increases to some level in stockholder capital. This results in an increase in ROE.

Figure 5 shows ROE in 2003. Hitachi, Victor, Sony, and Sharp have large ROE, meaning high safety margins, and high sales ratios. Mitsubishi and Matsushita have low ROE, and low sales rates. Fujitsu and Sanyo are irregular; both have very low ROE and low safety.

Thus, higher ROE (safeness), or heightened safety of borrowed capital, leads to a higher sales ratio in companies in the information industry. Figure 6 shows the result of a regression analysis of the selected companies, excluding Sanyo and Fujitsu. Victor scores a high value, at 4.33%, and compared with the other companies, stability is high. The ROE of Mitsubishi Electric is −2.99% and its stability is lower than the others. Fuzzy robust regression is applied on the data in Figure 5 to result in Figure 6. If the sales ratio is increased from Figure 6, all firms will have higher ROE. In Figure 6 Fujitsu and Sanyo are excluded because of being very lower.

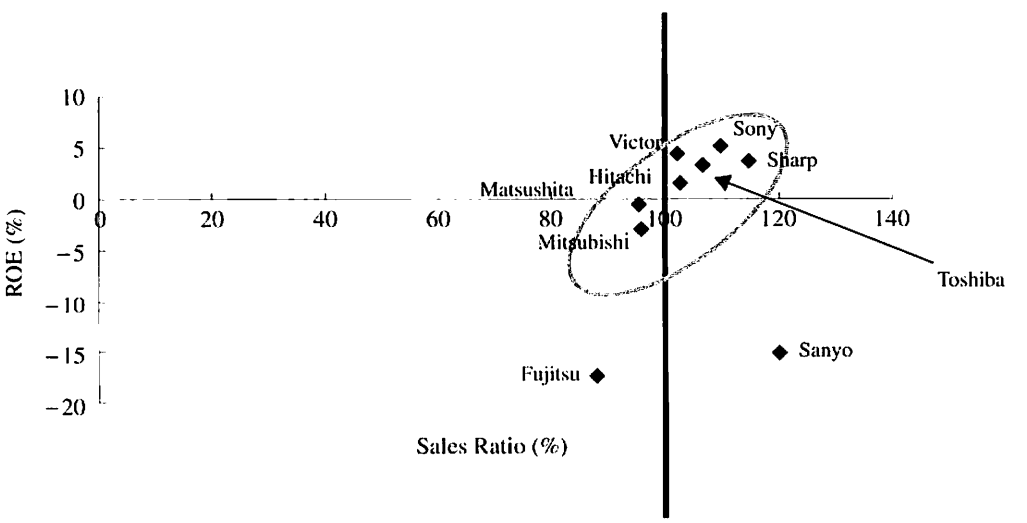
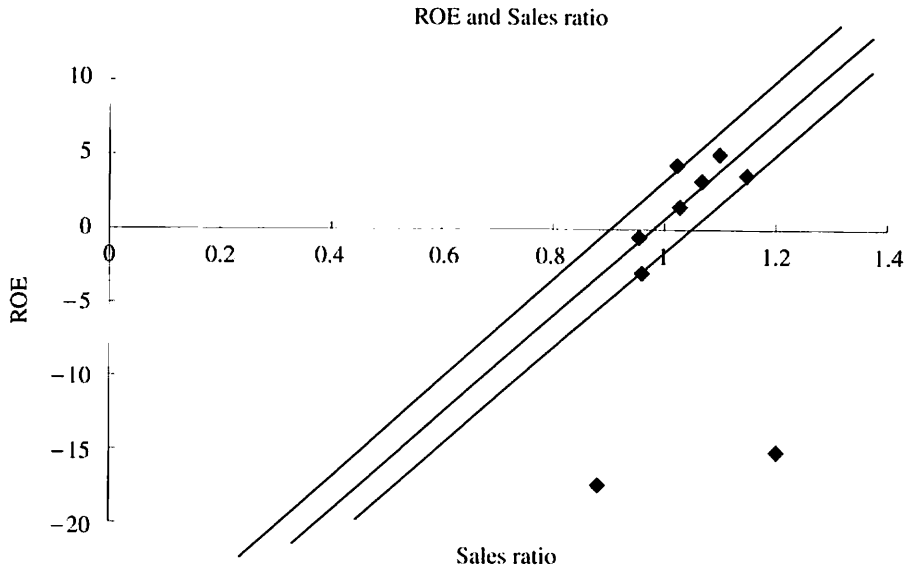


Figure 5. ROE and Sales Ratio



min $y = a0 + a1 \times x - (c0 + c1 \times x)$
center $y = a0 + a1 \times x$
max $y = a0 + a1 \times x - (c0 + c1 \times x)$

$a0 = -37$
$a1 = 37$
$c0 = 0$
$c1 = 2.5$

Figure 6. Fuzzy Robust Regression Analysis

3.3 ROA and sales ratio

ROA is written as follows.

$$\text{ROA} = \frac{\text{profit}}{\text{assets}}$$

ROA shows the increase in profits that can be obtained by investing into a company. For a business, this shows whether the company is run efficiently from the viewpoint of invested funds. In other words, it explains whether the management of a company is run well or not. Moreover, it shows whether funds are effectively employed and result in a good return from the viewpoint not only of stakeholders but also of fund donors including creditors. ROA is concerned with the availability of overall capital.

For example, Matsushita Electric Industrial has a low ROA, meaning a low efficiency of business capital. The company gets high grades in the area of corporate brand, but spent huge tangible assets to obtain it. The creation of a large cash flow was carried out using large assets. The roles of large cash flow and large assets are decreasing at present. In fact, large tangible assets can prevent a company from responding quickly, and may damage the brand. The value of ROA shows the growth potential of a company. The relation between ROA and sales ratio in 2003 is shown in Figure 7.

ROA tends to be higher at companies with a high sales ratio, with the exceptions of Mitsubishi Electric, Matsushita Electric Industrial and Fujitsu, whose sales ratios do not reach 100%. Moreover, the circle in Figure 7 shows that the sales ratio decreases except that a company has ROA and more than some extend and some growth.

Figure 8 illustrates the result of the fuzzy robust regression analysis from Figure 7 as well as Figure 6. In Figure 8, Toshiba and Sharp are higher than the trend of the analysis, and Sony is lower. It shows that in 2003, Toshiba and Sharp had high growth potential, whereas Sony's was low. Generally speaking, in an information company, the sales ratio increases, so ROA also increases. In Figure 8 Mitsubishi is excluded because is extremely.

3.4.1 Evaluation of brand value

Stockholders are becoming increasingly international. It is important to establish the brand badge including name, logo, design, etc. Companies are evaluated by their brand

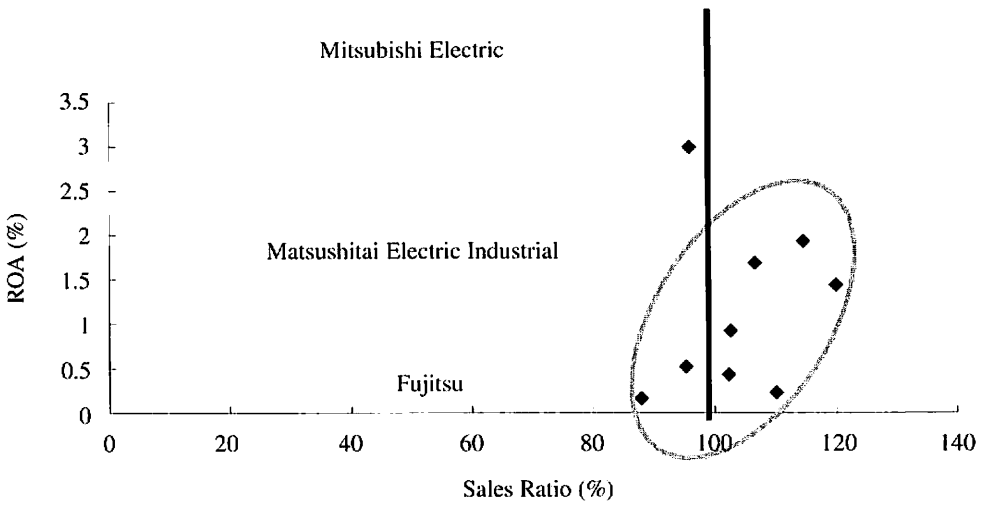
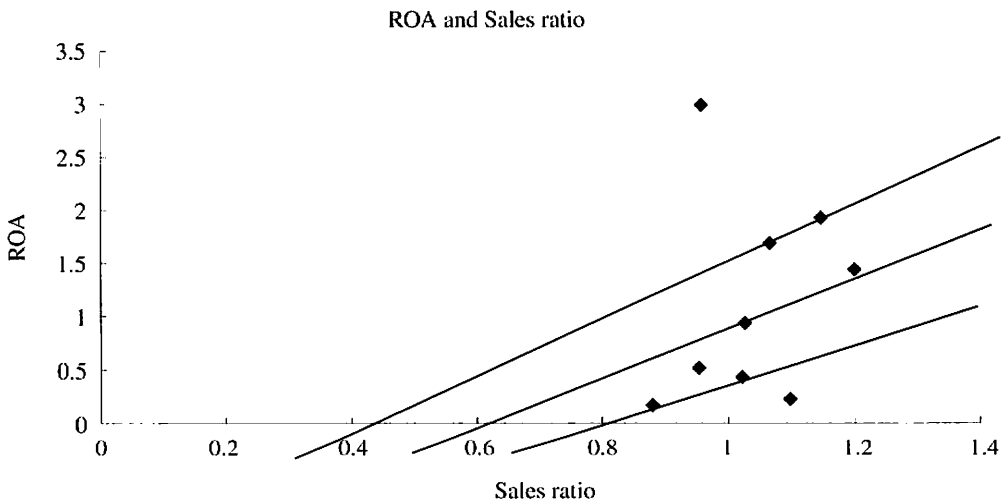


Figure 7. ROA and Sales Ratio



$$\min \quad y = a0 + a1 \times x - (c0 + c1 \times |x|)$$
$$\text{center} \quad y = a0 + a1 \times x$$
$$\max \quad y = a0 + a1 \times x + (c0 + c1 \times |x|)$$

$a0 = -1.5$
$a1 = 2.3$
$c0 = 0$
$c1 = 0.71$

Figure 8. Fazzy Robust Regression Analysis

badge, which is influenced by the quality of in-house products, function and status, and social trust. Companies need customers to recognize the unified nature of products with high quality and function, status, social trust through the brand badge.

3.4.2 Brand evaluation model

According to the brand evaluation model of the Ministry of Economy, Trade and Industry, brand value should be discounted by a discount rate on the assumption that the cash flow continues permanently. This can be rewritten as follows:

$$\text{brandvalue} = \frac{\text{PD} \times \text{LD} \times \text{ED}}{\text{r(Riskfreerate)}}$$

PD is an index expressing price dominance, meaning its ability to sell at a higher price than other companies in the same industry because of brand evaluation.

LD is an index of quantity sold, or of the stability of the quantity sales volume over a long period of time, by customers with loyalty and who are repeat customers.

ED is an index of the extension power of a brand, shown by the degree of advance into other areas, such as similar industries, different industries, and overseas.

3.4.3 Brand value and number of patents

This features in the model developed by the Ministry of Economy, Trade and Industry differs from the conventional approach. The expected cash flow corresponds to expected cash flow.

In Figure 10, the value for Mitsubishi Electric is low compared to the number of patents. However, it cannot be said that the number of patents is not adequately reflected in brand value. Generally speaking, as the number of patents increases, there is an increase in the brand value. Figure 10 is obtained by fuzzy regression analysis. X axis and Y axis are showed by natural logarithm.

3.4.4 Sales, operating revenue, and number of patents

The sales and the operating revenue, and number of patents are plotted in Figure 11.

Sony and Hitachi have relatively high sales and operating revenues in comparison to the number of patents, whereas for Toshiba it was low. Generally speaking, as the number of patents increases, sales and operating revenue also increases. Figure 12 is a obtained by fuzzy regression analysis. X axis and Y axis are showed by natural logarithm.

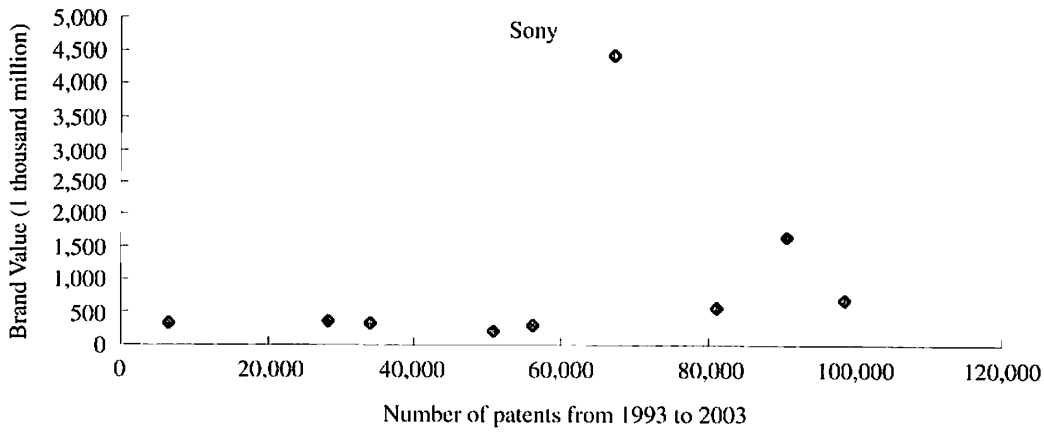
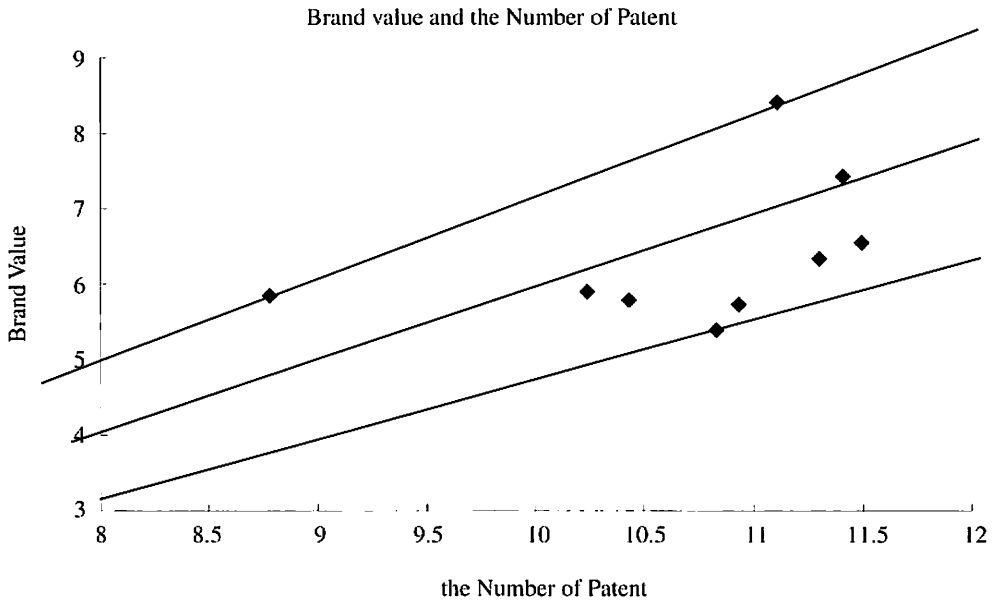


Figure 9. Brand Value and Number of Patents

Table 1. Brand Value, 2000

Corporation	Amount appraised (1 billion yen)
Sony	4428
Matsushita Electric Industrial	1661
Sharp	359
Victor Co. of Japan	344
Sanyo Electric	321
Toshiba	694
Hitachi	558
Fujitsu	302
Mitsubishi	215



min $\ln(y) = a0 + a1 \times \ln(x) - (c0 + c1 \times \ln|x|)$
center $\ln(y) = a0 + a1 \times \ln(x)$
max $\ln(y) = a0 + a1 \times \ln(x) + (c0 + c1 \times \ln|x|)$

$a0 = -3.7$
$a1 = 0.97$
$c0 = 0$
$c1 = 0.12$

Figure 10. Fuzzy Robust Regression Analysis

4. Discussion

In this analysis, we selected nine companies — Sony, Matsushita Electric Industrial, Sharp, Victor Co. of Japan, Sanyo Electric, Toshiba, Hitachi, Fujitsu, and Mitsubishi Electric — and analyzed their intangible management resources. We did not use capital, but looked at the number of patents in the term from 1999 to 2003, the sales ratio (obtained by dividing sales in 2003 by sales in 1999 and multiplying 100), ROE and ROA, stock aggregate market value, etc. using the Ministry's of Economy, Trade and Industry's corporate

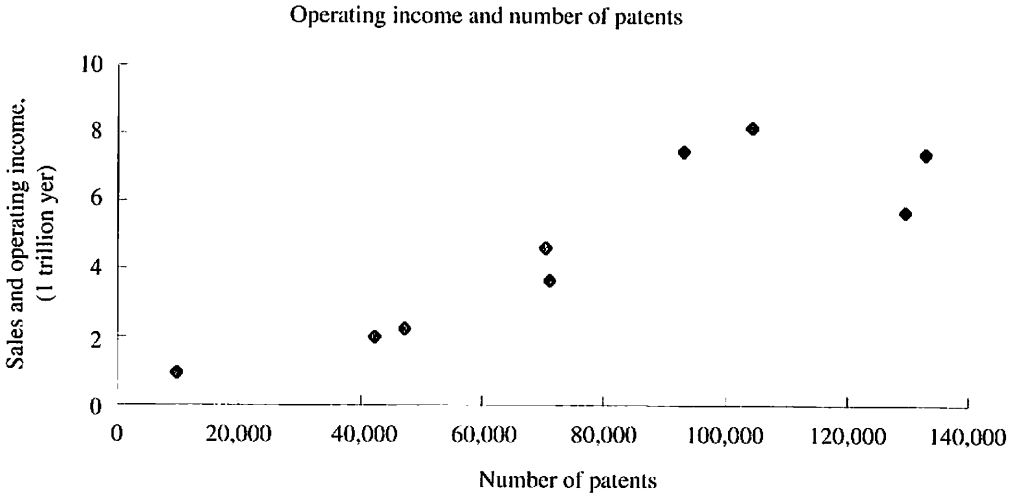
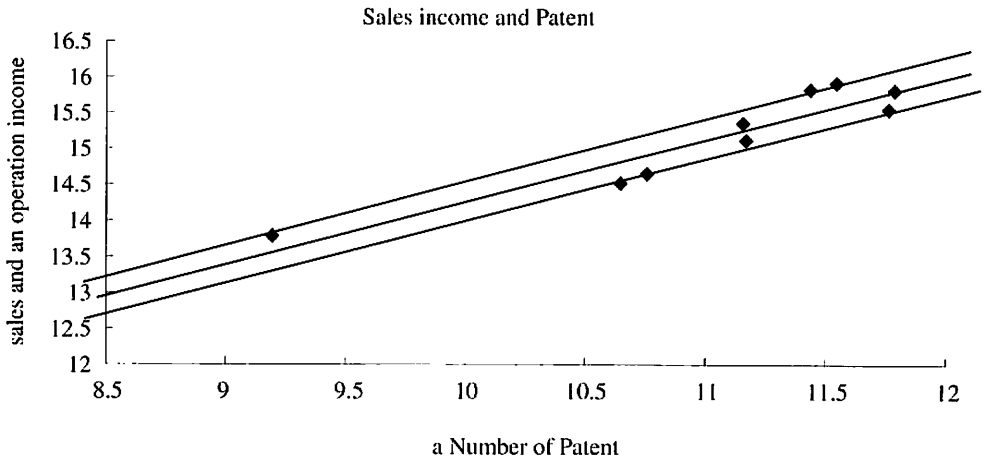


Figure 11. Sales and Operating Income, and Number of Patents



min $\ln(y) = a0 + a1 \times \ln(x) - (c0 + c1 \times \ln|x|)$

center $\ln(y) = a0 + a1 \times \ln(x)$

max $\ln(y) = a0 + a1 \times \ln(x) + (c0 + c1 \times \ln|x|)$

$a0 = 5.4$
$a1 = 0.9$
$c0 = 0$
$c1 = 0.028$

Figure 12. Fuzzy Robust Regression Analysis

brand evaluation, and sales. As shown in the figures, ROE, sales ratio, ROA and sales ratio, corporate brand value, number of patents, and sales, operating income and number of patents showed a tendency. The sales ratio, and sales and operating income were calculated in the term to serve as a benchmark of company scale. It is difficult to compare company in general terms using differences in strategies, areas of strength, company scale, etc.

First, Sony leads in ROA and ROE. The other companies are far behind in terms of aggregate stock market value, intangible management resources, etc., though they still obtain good results. Probably for this reason, the ratio of sales and operating income to the number of patents had a high correlation in the regression analysis value also for brand

value.

For Matsushita Electric Industrial, the sales ratio is low. Since it is close to the regression analysis line, the ROE and ROA are also low. Unlike Sony, its aggregate stock market value and intangible management resources, etc. are similar to the other companies. But like Sony, its brand value is high. It can be said that the efficiency of brand value over the number of patents is slightly higher than the other companies. Moreover, looking at the ratio of sales and operating income to patents, it is generally on a regression analysis line. Subsequently, as for Toshiba, Matsushita Electric Industrial has many patents. For Toshiba, both ROE and ROA are on the regression line when compared to the sales ratio, brand value, and sales and operating incomes. Its company scale is large, and it is a typical company in the information technology industry. Looking at factors that are not on the regression analysis line in other companies, the ROE to sales ratio is extremely low, showing a lack of management stability, in Fujitsu and Sanyo Electric. Moreover, Mitsubishi Electric's ROA is very far from the others, as it has obtained good results, and it can be said that its growth potential is very high.

5. Conclusions

The data used in this paper are interlinked financial data. These financial data are converted into accounting for consolidation initiative from individual accounting earnings in recent years. In the present age, information disclosure spreads globally and Japan cannot afford not to do so as well. Since many factors change greatly according to company scale or corporate strategies, it is difficult to make general comparisons. It seems that the poorly-defined elements have increased, and the particular features of each company have become clear, so that in Figure 12 there are large discrepancies. Analyzing more samples in detail remains as a task for the future. It is often argued that the number of patents serves as an effective index to evaluate companies in the information industry. However, the particular characteristics and strategies of each company have a direct influence on sales, determining whether it can become a larger-scale company. Moreover, in the information industry there are many opportunities, so the situation can be easily affected by factors of uncertainty. In recent years, the presence of China, which has attracted attention as the world's largest potential market, is also large. Of course technical innovation must be carried out in accordance with information and communications policy, economy, social needs, etc. in a flexible and immediate way. Companies must bear this in mind if they want to make further progress.

Notes

1 On July 3 2002, the intellectual property strategy committee of the Japanese government made a proposal for a pro-patent (pro-intellectual property) policy. Although there has been criticism of the policy for being "insufficient," its stated aim is for Japan to become one of the best countries for the protection of intellectual property rights (Asahi.com July 3, 2002).

2 Complementary Metal-Oxide Semiconductor. CMOS has the merit of allowing a decrease in power consumption. Today, most microprocessors use CMOS.

3 Large scale Integration. An LSI is an IC which consists of a number of element from 1,000 to 100,000.

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